Concept for Anti-Cavitation Water Injecting Propeller Blades for Quiet Submarine Performance at High Speeds

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Introduction

Ordinary propeller blades, no matter how well-crafted, cannot help but generate cavitation when their speed relative to the surrounding water is too high. The compression of water by the blades generates tiny air bubbles, the creation of which can be heard from dozens of miles away by sonar systems.

Abstract

I propose a specially designed propeller in which a section of the blades themselves double as thin water ducts which inject water drawn from the non-pressurized seawater component of the reactor cooling system into the vicinity of cavitation zones in a particular fashion that prevents bubble formation.

In the moments before typical cavitation events, water first begins to convect in a series of miniature vortices coming around from the side of the blade closest to the submarine and wrapping around to the back, where bubbles form near the sharp edge of the blade.

To counteract this, a duct may be built into the shipboard side of a propeller blade to inject water, which passes over a small hump in the duct to get the water rotating in the opposite direction of the vortices that lead to cavitation. In our case, the focus isn't necessarily on preventing vortices from forming, but on preventing their whipping around the side of the blade and generating bubbles. If we can allow the blade to interact with the water while preventing rotationally active fluid from striking the blade by introducing water rotating in the inverse direction, we can eat our proverbial cake and still have it at the end.

Given that it is generally known what rate of rotation is tolerable while safely avoiding cavitation, our vortex generation injectors should be geared toward generating somewhat less than that amount of rotational energy, but with its position and direction of orientation focused on counteracting fluid constantly trying to wrap around from the front side of the blade.

Conclusion

By preventing micro-vortices from impacting the blade (the system would redirect them in a direction of no consequence,) nearly all cavitation may be prevented at any speed of rotation of a propeller blade.